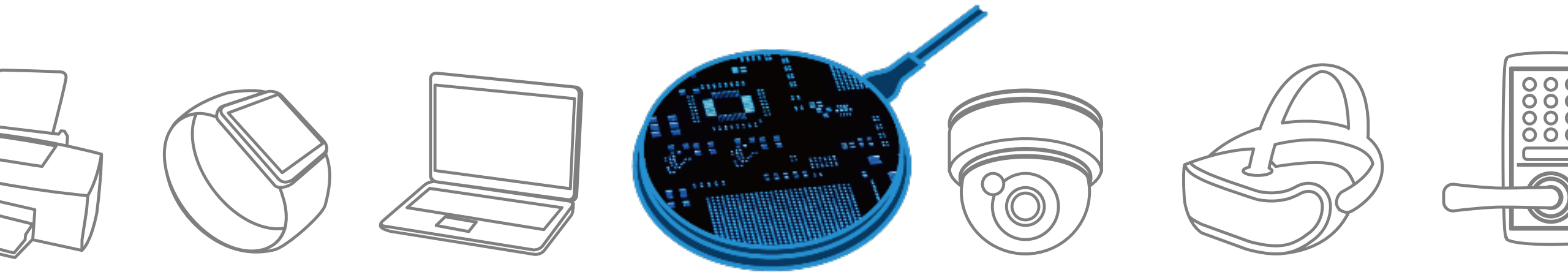
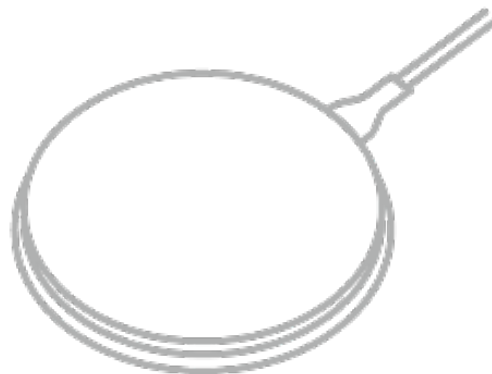


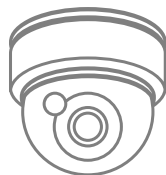
# Wireless Charger

**Solution Proposal by Toshiba**

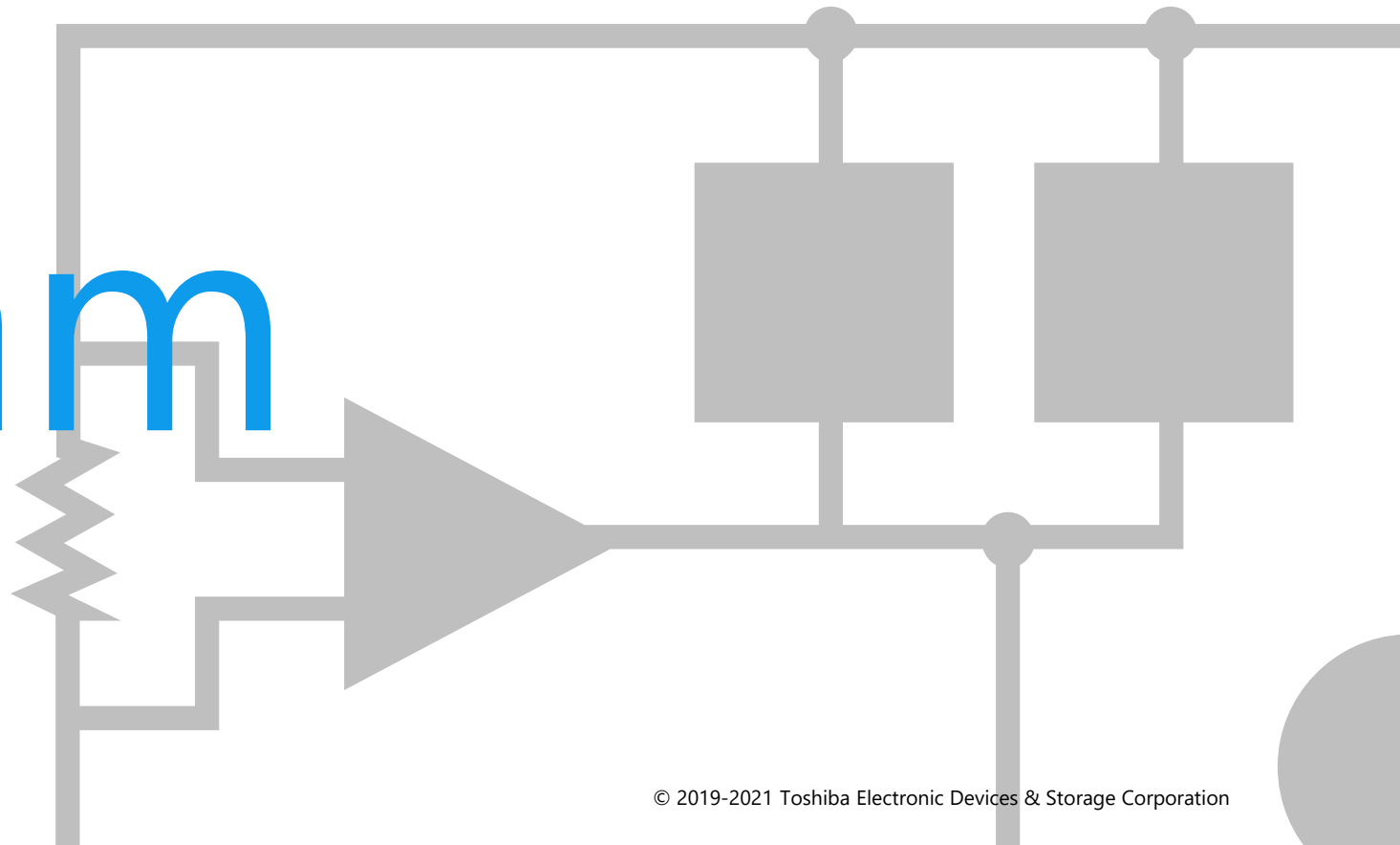




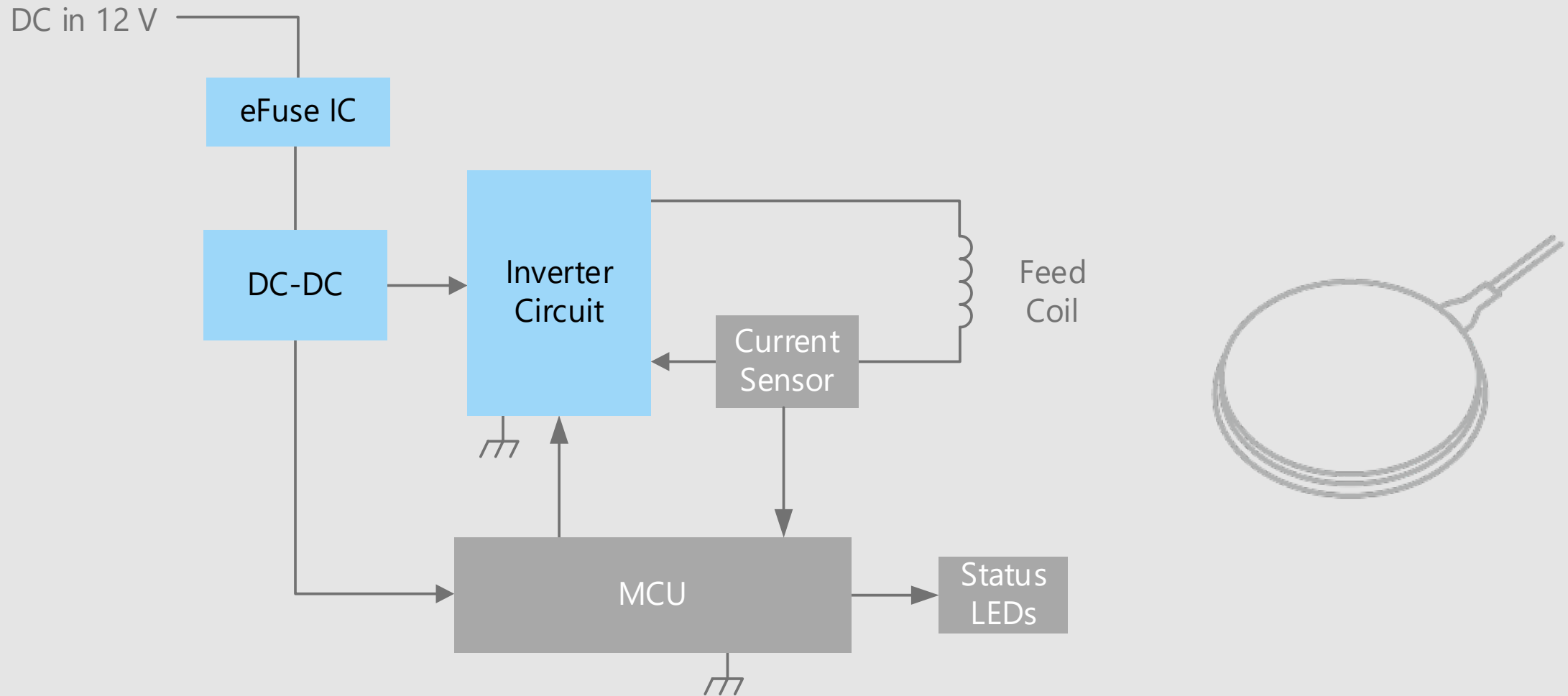
Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.



# Block Diagram

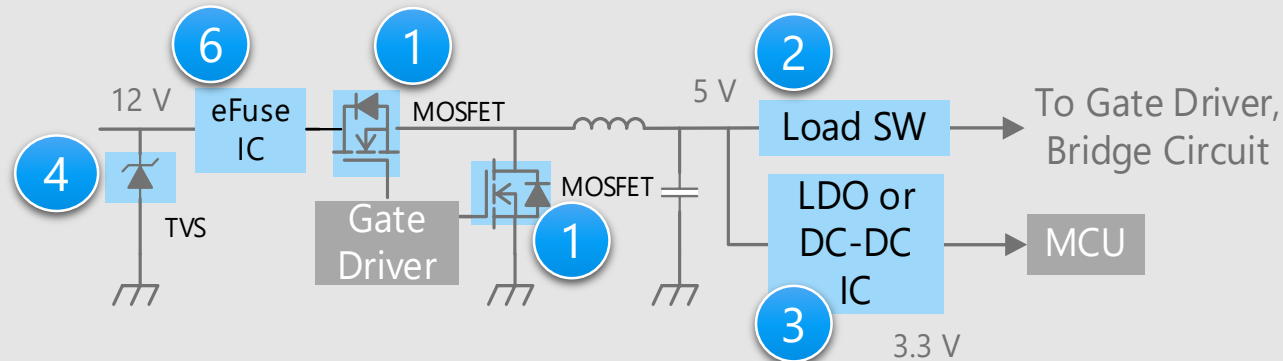


# Wireless Charger Overall block diagram

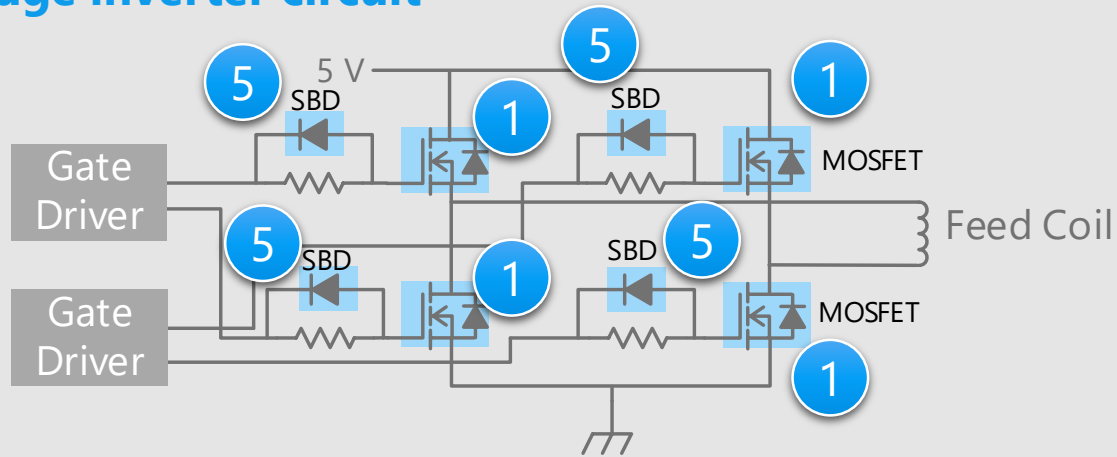


# Wireless Charger Detail of power supply circuit unit

## IC-driven DC-DC power supply circuit



## Full-bridge inverter circuit



※ Click the number in the circuit diagram to jump to the detailed description page

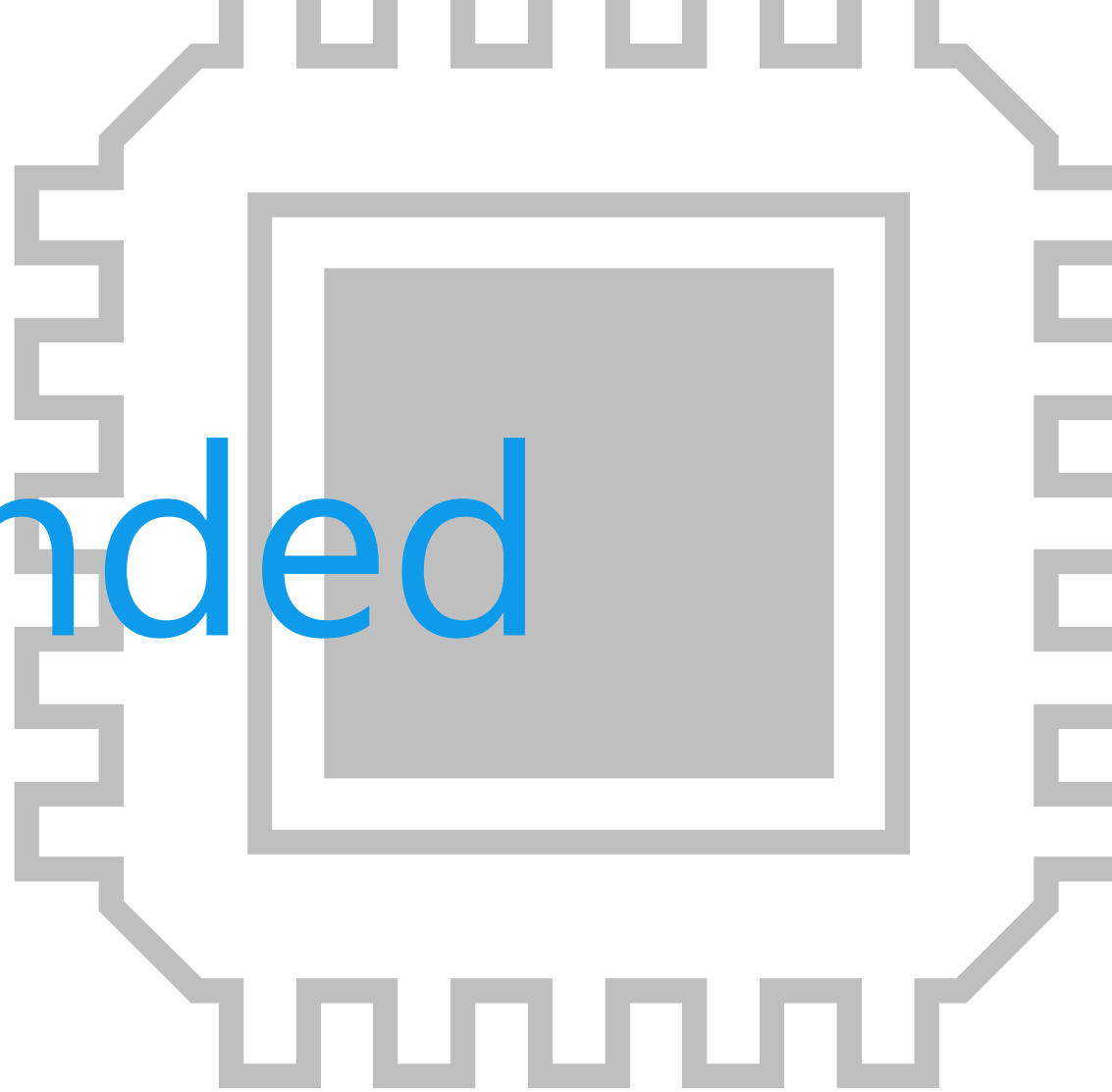
## Criteria for device selection

- A high voltage MOSFET is required considering such as counter electromotive force of the feed coil.
- The use of low consumption products can improve the overall efficiency of the system.
- The circuit board area can be reduced by adopting small package products.

## Proposals from Toshiba

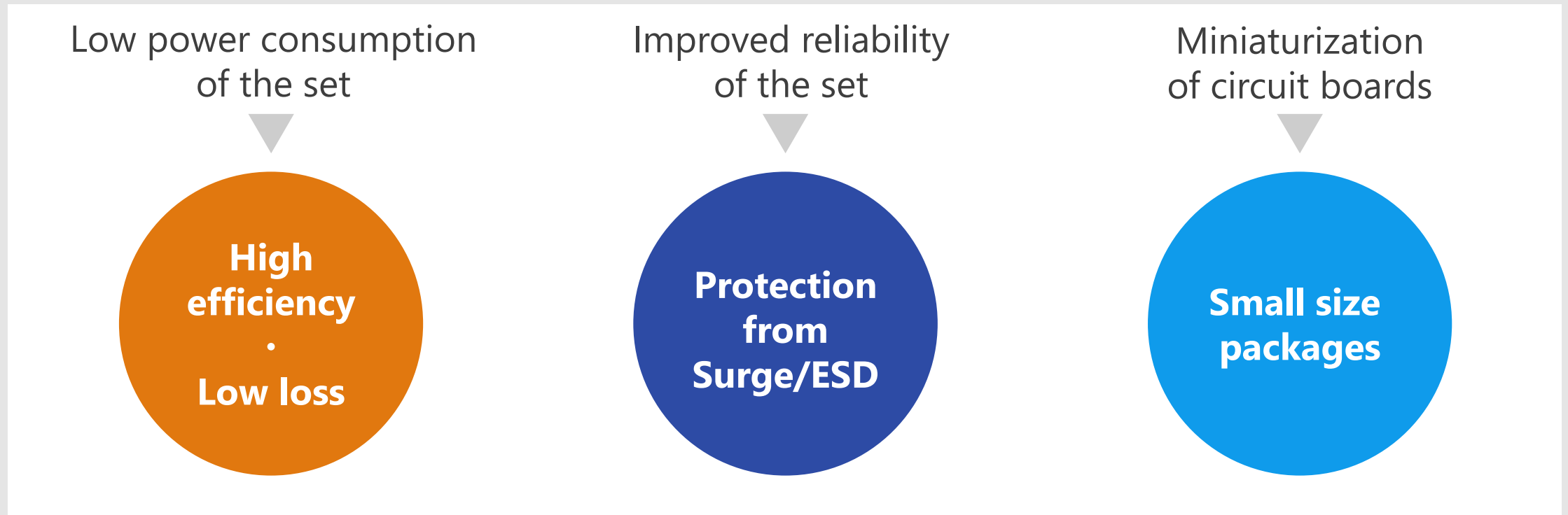
- **The set of low power consumption is realized by the low on-resistance**  
U-MOS Series power MOSFET (1)
- **It contributes to low power consumption of the system.**  
Load switch IC (2)
- **Low dropout LDO contributes to high efficiency**  
Small surface mount LDO regulator (3)
- **Small size package is suitable for high density assembly**  
TVS diode (4)
- **Low  $V_f$  shortens off-time. Suppress the through current and improve efficiency.**  
Schottky barrier diode (5)
- **Robust protection function**  
Electronic fuse (eFuse IC) (6)

# Recommended Devices



# Device solutions to address customer needs

As described above, in the design of wireless charger, “**Low power consumption of the set**”, “**Improved reliability of the set**” and “**Miniaturization of circuit boards**” are important factors. Toshiba’s proposals are based on these three solution perspectives.



# Device solutions to address customer needs

High efficiency  
-  
Low loss

Protection from  
Surge/ESD

Small size  
packages

①	<b>U-MOS Series power MOSFET</b>	●		●
②	<b>Load switch IC</b>	●	●	●
③	<b>Small surface mount LDO regulator</b>	●		●
④	<b>TVS diode</b>		●	●
⑤	<b>Schottky barrier diode</b>	●		●
⑥	<b>Electronic fuse (eFuse IC)</b>	●	●	●



Value provided

Lineup of low on-resistance products is provided and trade-off between on-resistance and capacitance contribute to higher power supply efficiency.

## 1 Fast switching speed

Reducing switching loss through high-speed operation contributes to higher power supply efficiency.

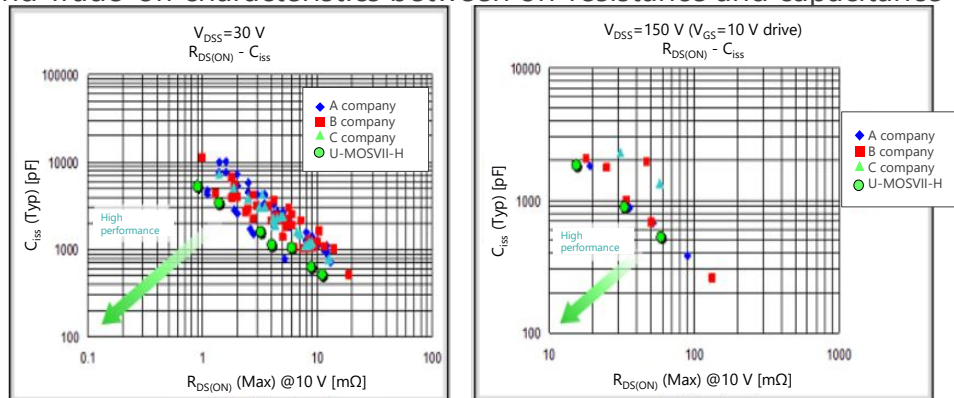
## 2 Small gate input charge

Small gate input charge reduces the performance required for driving the MOSFET. It contributes to improving switching characteristics.





## 3 Low on-resistance

By reducing the on-resistance between the source and drain, heat generation and power consumption can be kept low.

Lineup of low on-resistance products and Trade-off characteristics between on-resistance and capacitance



### Line up

Part number	TPN7R504PL	TPN19008QM	TPN8R408QM	TPN12008QM	TPH7R204PL	TPH2R408QM	TK90S06N1L
Package	TSON Advance 			SOP Advance 		SOP Advance(N) 	DPAK+ 
V <sub>DSS</sub> (Max) [V]	40	80	80	80	40	80	60
I <sub>D</sub> (Max) [A]	38 (68*)	34 (38*)	32 (77*)	26 (60*)	48 (72*)	120 (200*)	90
R <sub>DS(ON)</sub> [mΩ] @V <sub>GS</sub> = 10 V	Typ.	5.6	14.7	6.5	9.6	5.4	1.9
	Max	7.5	19	8.4	12.3	7.2	2.43
極性	N-ch	N-ch	N-ch	N-ch	N-ch	N-ch	N-ch
世代	U-MOSIX-H	U-MOSX-H	U-MOSX-H	U-MOSX-H	U-MOSIX-H	U-MOSX-H	U-MOSVII-H

\* : Silicon limit

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Value provided

## Low on-resistance is realized and it contributes to high power supply efficiency.

### 1 Low on-resistance

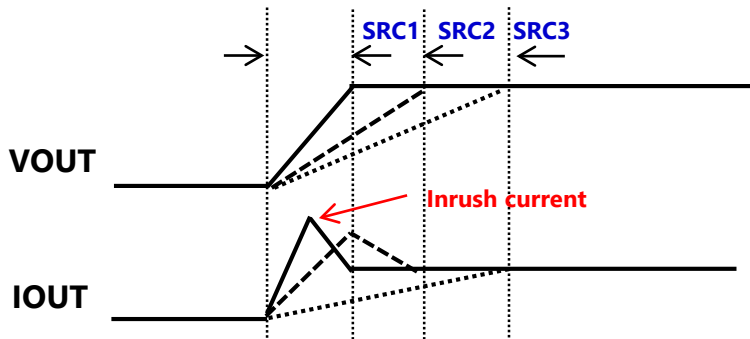
By keeping the on-resistance low, heat generation and power consumption can be kept low.

### 2 Adjusting the output rise time

You can select products that are suitable for reducing power consumption, miniaturization of the system, sequence control and latch current suppression.


### 3 Optimal for high density mounting

The compact 0.4 mm pitch package WCSP6E (0.8 mm x 1.2 mm) enables high density mounting.



The inrush current can be reduced by selecting a slew rate (fixed value) suitable for the load.

#### Line up

Part number	TCK2292xG	TCK2297xG
Package	WCSP6E	
$V_{IN}$ [V]	1.1 to 5.5	
$I_{OUT}$ (Max) [A]	2	
$R_{ON}$ (Typ.) [mΩ] @ $V_{IN} = 5$ V	25	
Slew Rate	4.5 μs, 666 μs, 1.364 ms, 3.38 ms	
Quick output discharge	✓	-

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# 3 Small surface mount LDO regulator

TCR15AG / TCR5BM / TCR3UG / TCR3DG Series

High efficiency  
Low loss

Protection from  
Surge/ESD

Small size  
packages

Value provided

Variety of products that meet high performance requirements, from general-purpose package to small package type.

## 1 Low dropout voltage

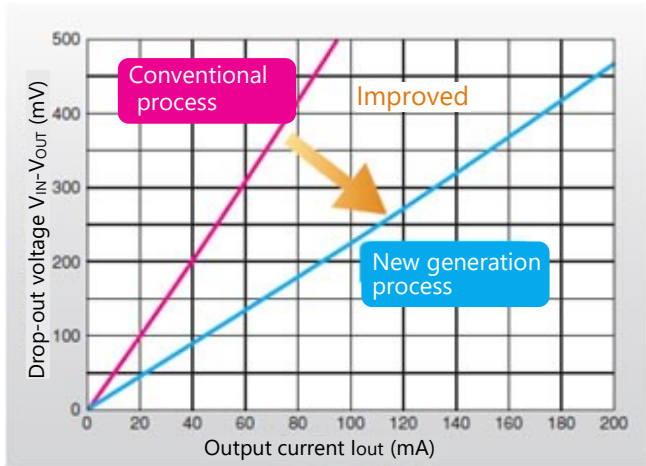
The newly developed new-generation process significantly improved the drop-out characteristics.

## 2 High ripple rejection

Our LDO regulator has a high ripple rejection characteristic, and eliminates switching noise efficiently.

## 3 Ceramic capacitors can be used.

Improved drop-out characteristics have enabled the use of ceramic capacitors as external capacitors.



Note: Toshiba internal comparison

### Line up

Part number	TCR15AG Series	TCR5BM Series	TCR3UG Series	TCR3DG Series
Package	WCSP6F 	DFN5B 	WCSP4F 	WCSP4E 
$I_{OUT}$ (Max) [A]	1.5	0.5	0.3	0.3
$V_{DO}$ (Typ.) [mV]	120 @ $I_{OUT} = 1.5$ A	100 @ $I_{OUT} = 500$ mA	140 @ $I_{OUT} = 300$ mA	195 @ $I_{OUT} = 300$ mA
R.R. (Typ.) [dB]	95	98	70	70
$I_B$ (Typ.) [ $\mu$ A]	25	19	0.34	65

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Value provided

To use of TVS diode with compact package is ideal for protecting against ESD and surge by high density mounting.

## 1 Line up according to voltage

Multiple voltage-resistant products are available, and products can be selected according to the power supply voltage.

## 2 Absorb high surge current

It can withstand high peak pulse current ( $I_{PP}$  [Note 2]).

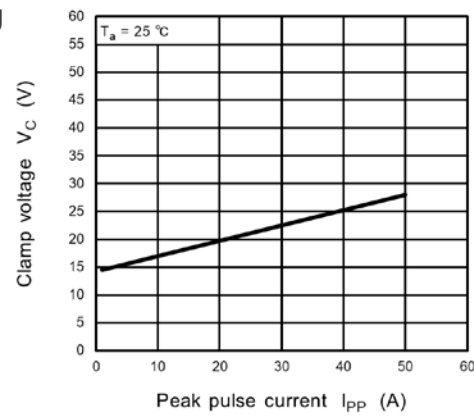
## 3 Small package

Two types of small packages are available.  
 USC : 2.5 x 1.2 mm  
 CST2C : 1.6 x 0.8 mm



[Note 1] acc. to IEC61000-4-2(contact) [Note 2] acc. to IEC61000-4-5

High peak pulse current ( $I_{PP}$ ) can be absorbed.

(Reference) DF2S14P2FU



### Line up

Part number	DF2S6P2FU DF2S6P2CTC	DF2S12P2FU DF2S12P2CTC	DF2S14P2FU DF2S14P2CTC	DF2S23P2FU DF2S23P2CTC
Package	USC		CST2C	
$V_{RWM}$ (Max) [V]	5.5	10	12.6	21
$V_{ESD}$ (Max) [kV] [Note 1]	±30			
$I_{PP}$ (Max) [A] [Note 2]	80	60	50	14

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Value provided

Wide voltage line-up using compact package with high power dissipation, and turn off the gate voltage quickly due to the low  $V_F$  characteristic.

### 1 Compact package with high power dissipation

Products are suitable for various power dissipation level.

Low thermal resistance

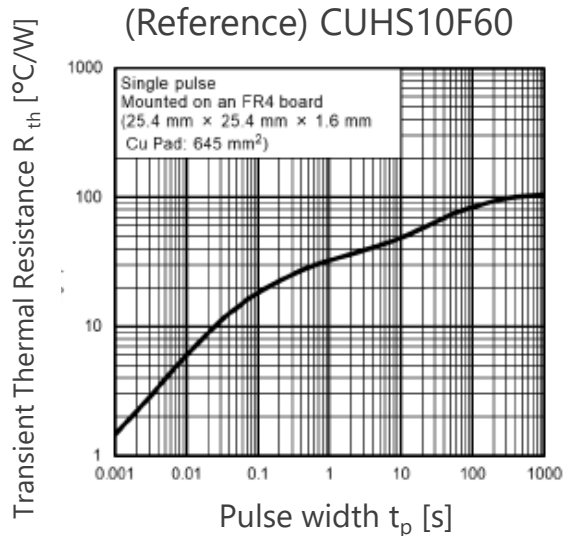
$(R_{th(ja)}) = 105 \text{ } ^\circ\text{C/W}$  [Note]

### 2 Line-up of various products

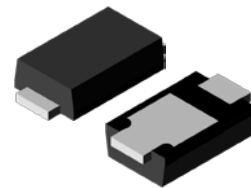
Products line-up offers products with reverse voltage  $V_R$  up to 30 V, 40 V and 60 V.

### 3 Low $V_F$

Low forward voltage can turn off the gate voltage quickly, it improve switching characteristic and power efficiency.




Note: FR4 board mounting (25.4 mm × 25.4 mm × 1.6 mm, Cu Pad: 25.4 mm x 25.4 mm)



US2H  
(2.5 x 1.4 mm)

Easy to thermal design by low transient thermal resistance

#### Line up

Part number	CUHS20F30	CUHS20F40	CUHS10F60
Package	US2H 		
$V_R$ (Max) [V]	30	40	60
$I_O$ (Max) [A]	2	2	1
$V_F$ (Typ.) [V] @ $I_F = 1 \text{ A}$	0.35	0.39	0.56

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# 6 Electronic fuse (eFuse IC)

## TCKE8 Series

High efficiency  
Low loss

Protection from Surge/ESD

Small size packages

Value provided

**eFuse IC of electronic fuse that can be used repeatedly to protect circuits from abnormal conditions such as overcurrent and overvoltage.**

### 1 Repeatedly usable

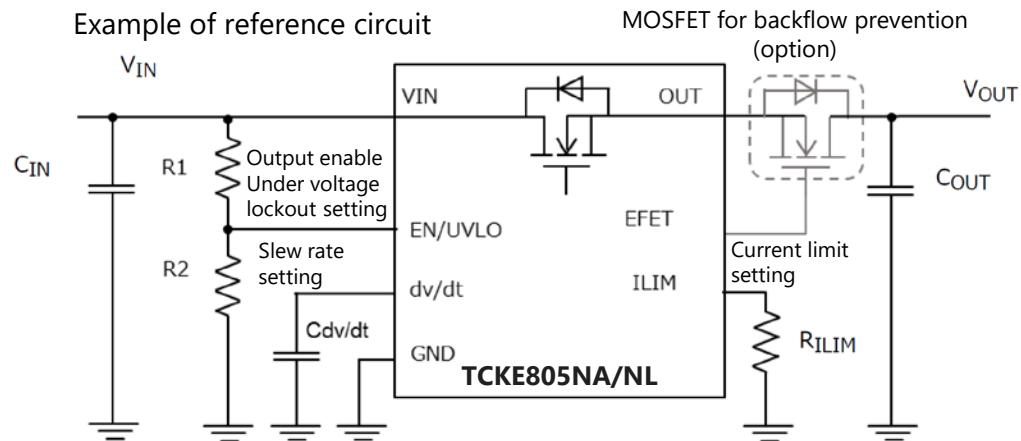
When overcurrent flows through the electronic fuse (eFuse IC), the internal detection circuit operates and switches off the internal MOSFET. It is not destroyed by a single overcurrent and can be used repeatedly.

### 2 High-speed switch off characteristics

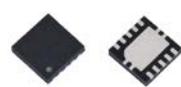
The switch off time at the time of fast trip is as fast as 150 ns (Typ.).

### 3 Rich protection functions

In addition to short-circuit protection, the circuit is protected by overcurrent clamp function (OCC), overvoltage clamp function (OVC), thermal shut down (TSD), inrush current suppression, backflow prevention (optional) and other protection functions.



### Line up

Part number	TCKE800NA/NL	TCKE805NA/NL	TCKE812NA/NL
Package	WSON10B 3.0 x 3.0 x 0.7 mm 		
$V_{IN}$ [V]	4.4 to 18		
$R_{ON}$ (Typ.) [m $\Omega$ ]	28		
Return function	NA: Automatic return, NL: Latch type (external signal control)		
$V_{OVC}$ (Typ.) [V]	-	6.04	15.0

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